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FORACS TEST PROCEDURES FOR MK 92 MOD 2 FIRE CONTROL SYSTEM, STA--ETC(U)
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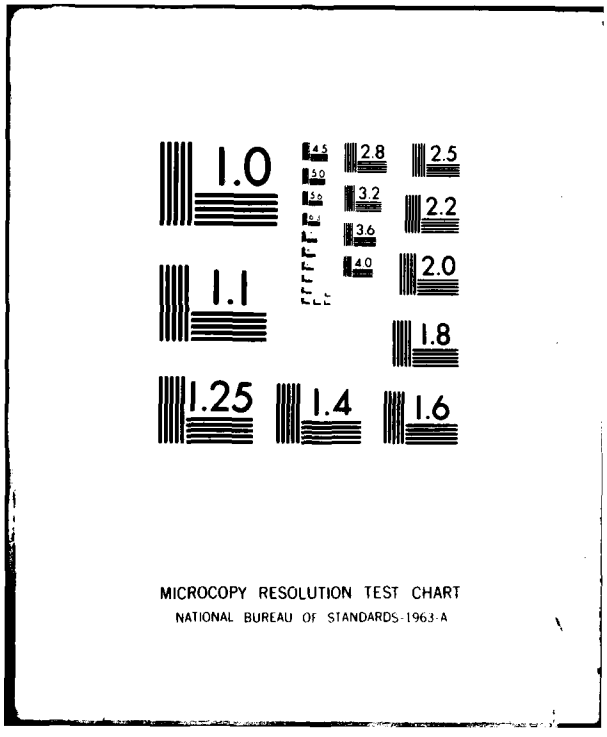
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Technical Document 311

FORACS TEST PROCEDURES FOR MK 92 MOD 2 FIRE CONTROL SYSTEM

Standardized testing of modified MK 92 FCS on FFG 7 class platforms, at Fleet Operational Readiness Accuracy Check Sites

ER Aughinbaugh

11 December 1979

Prepared for
Naval Sea Systems Command (Code 63C)
Washington DC 20362

Approved for public release; distribution unlimited

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METRIC CONVERSION

To convert from	to	Multiply by
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The purpose of this instruction is to provide a standardized procedure for testing the MK 92 MOD 2 Fire Control System (FCS) installed on FFG 7 class platforms, at Fleet Operational Readiness Accuracy Check Sites (FORACS).

This instruction cancels FORACSINST 9017, August 1979.

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PURPOSE

The purpose of this instruction is to provide a standardized procedure for testing the MK 92 MOD 2 Fire Control System (FCS) installed on FFG 7 class platforms.

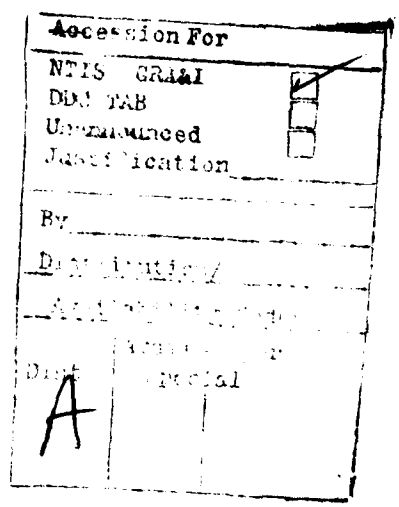
NOTE

This instruction cancels FORACSINST 9017, August 1979.

BACKGROUND

The MK 92 MOD 2 FCS is a modified and expanded Dutch design, (~~fig 1~~) The system was originally intended as a gun control system, designated MK 92-1 Gun Fire Control System (GFCS), which used a single antenna called the combined antenna system (CAS). The CAS is comprised of a search antenna located on the lower side of a stabilized platform and a track antenna located on the upper side of this platform, with the entire assembly enclosed in a fiberglass shock-mounted dome. With the addition of a separate track and illumination radar (STIR) as missile control, the system becomes the MK 92-2 FCS.

The MK 92-2 FCS has a capability of tracking four targets simultaneously on its three tracking antennas. The CAS track antenna can track one target, and the CAS search antenna provides data for a track-while-scan (TWS) system capable of tracking two targets. These two X-band systems are driven by a common transmitter through a power splitter. The STIR antenna tracks one target and is driven by its own X-band transmitter. All three systems are controlled by an AN/UYK-7 digital computer, which in turn is controlled by two weapon control consoles, WCC-2 on the left and WCC-1 on the right. The CAS tracker is monitored and controlled from WCC-1 and is designated FC-1. The CAS search system is also monitored and controlled from WCC-1, and its two TWS channels are designated FC-4 and FC-5. The STIR system is monitored and controlled from WCC-2 and is designated FC-2. No FC-3 channel presently exists; FC-3 is planned for future use as an optical sight.



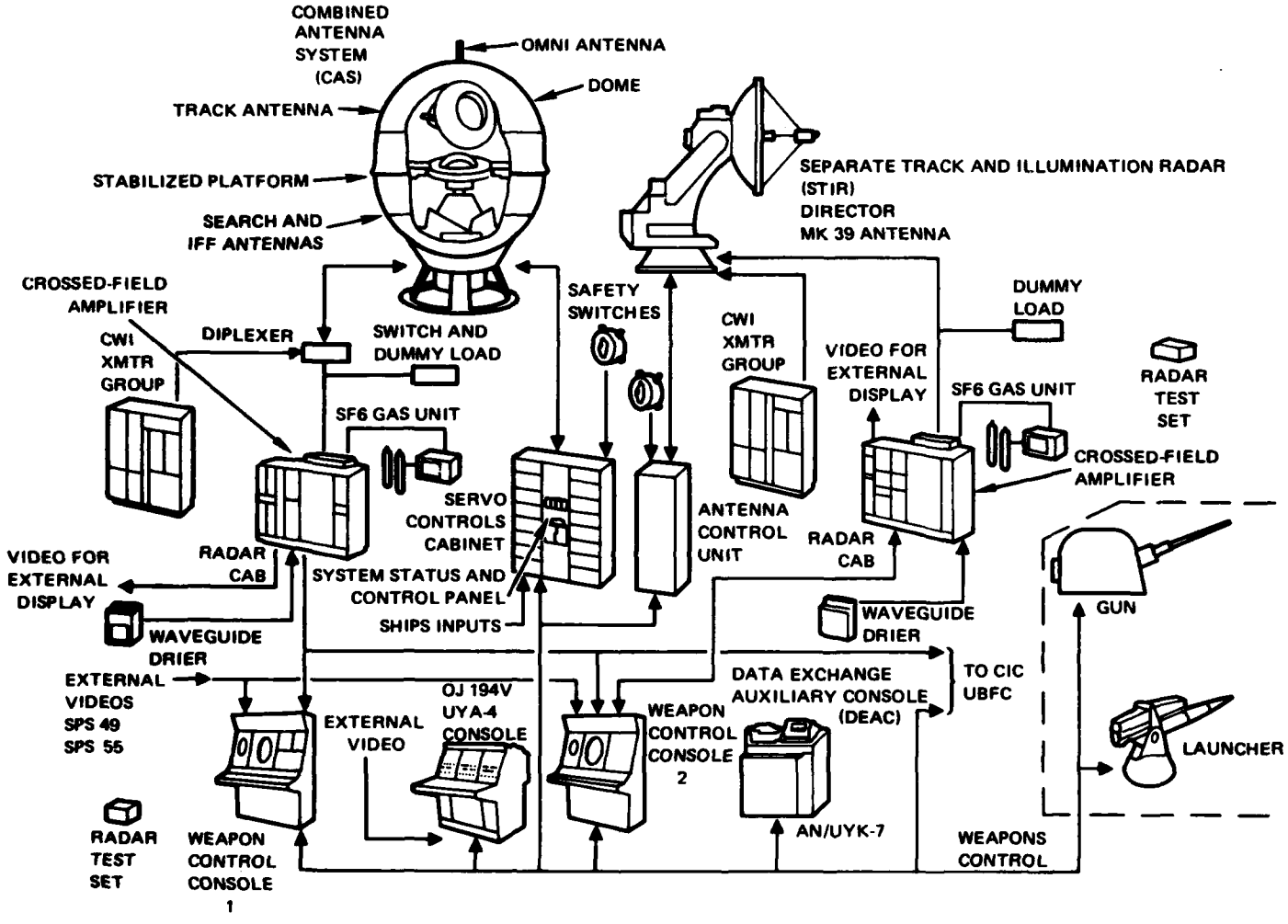


Figure 1. MK 92 MOD 2 Fire Control System.

DOCKSIDE PROCEDURES

Train alignment checks, benchmark/lost-motion checks, and a gyro settled-error test shall be performed dockside. Two dockside days will normally be scheduled; if the dockside schedule is less than this, train alignment checks may be eliminated. The gun fire-control system (GFCS) reference element is the gun. The FORACS heading reference theodolite will be cross-leveled to this element.

ALIGNMENT CHECKS

Only one antenna system, the STIR, is easy to check optically for alignment. The CAS dome has an optic mount to enable a limited field of benchmark adjustment. Since the track antenna is hidden from view inside the CAS dome, optical alignment is impossible unless the dome is removed. The optical alignment relationship of the STIR, gun, and launcher shall be done to establish a baseline for comparison to on-range radar data acquired from the STIR and CAS, thus providing an overview of element alignment interrelationships. Benchmark data acquired on the STIR shall be compared to the smooth log data and reported.

1. Perform director lost-motion checks on the MK 54 STIR by use of the MK 104 or MK 118 telescope. Read train and elevation at the director.

2. Perform train alignment checks on the STIR, gun, and launcher by use of the FORACS reference-line theodolite and two dockside theodolites.

MK 92 GYROCOMPASS TEST

The MK 92 gyro is the heading, pitch, and roll reference element and normally is slaved to the master gyro. The failure or "free drift" mode can be forced by turning switch 107 at the FCS switchboard from BOTH to SDC. The gyro is read at the signal data converter (SDC) in the equipment space. Since the MK 92 gyro has no north-seeking capability, it should be warmed up for a period of 4 hours in the slave mode.

1. On the first mark of the settled-error test, switch to the free-drift mode and acquire data for 2 hours.

2. After 2 hours of free-drift data, switch back to the slave mode and continue taking data for another 30 minutes. All data should be taken concurrently with the master gyrocompass data.

READOUT LOCATIONS

The following are readout locations for the various elements tested during dockside checks.

Element	Location	Resolution
STIR	STIR train dial and/or DEAC teleprinter	1 minute 0.01°
Gun	Gun train dial (inside mount)	1 minute
Launcher	Launcher train dial (in magazine)	1 minute
Gyro	Signal data converter (SDC) (equipment space)	0.01°

ON-RANGE PROCEDURES

Normally 2 on-range days will be scheduled. All four fire control channels will be operated in "automatic," with bearing and range recorded on the system magnetic tape. If manual data acquisition is desired, follow the procedure included herein as appendix A.

EQUIPMENT SETTINGS

Frequency

CAS (FC-1, -4, and -5) transmitter (9200 MHz), STIR (FC-2) transmitter (9400 MHz) and AN/SPS-55 transmitter (9600 MHz) should be tuned to frequencies separated by no less than 200 MHz. This allows tuning of the X-band radar transponder to a discrete system frequency for independent nonanomalous acquisition of extended range data.

Pulse Mode

Crossed-field amplifiers (CFA) – Off

Pulse amplitude/pulse Doppler – Pulse amplitude

Track Mode

Automatic

Pulse Width

CAS – 0.53 ± 0.053 μs (long pulse)

STIR – 1.0 ± 0.1 μs

AN/SPS-55 – 0.22 ± 0.022 μs (short pulse)

TRACKING STATION

FC-1 – Combined antenna system (CAS) tracker is assigned, controlled, and monitored at weapon control console 1 (WCC-1) right-hand TOTE.

FC-2 – Separate track and illumination radar (STIR) air tracker is assigned, controlled, and monitored at WCC-2 left-hand TOTE.

FC-4 and -5 – CAS search/track-while-scan (TWS) channels are assigned, controlled, and monitored at WCC-1 right-hand TOTE.

RECORDING STATION

All data shall be recorded on the ship's recording system at 1 Hz. The FORACS team should provide at least four half-inch wide, 10-inch diameter tapes to the ship for data recording. The tapes may be erased and reused for follow-on ships. In addition to the "mark" numbers and elapsed time in seconds, the following nine parameters will be recorded:

FC-1 – Relative bearing (to 0.01°) and range (yards)

FC-2 – Relative bearing (to 0.01°) and range (yards)

FC-4 – True bearing (to 0.01°) and range (yards)

FC-5 – True bearing (to 0.01°) and range (yards)

Signal data converter (SDC) – Own-ship heading (to 0.01°)

The "mark" number is written on the tape as the "range offset target location" (OTL), which has an FCS symbol of q (R ℓ 4)^5. At each mark number the following four buttons are sequentially pressed at FC-5: RANGE, PLUS RIGHT ADD UP, 1, and INSERT. The first three buttons may be pressed at any preparatory time. The last button, INSERT, must be pressed as the FORACS "mark" is called.

If on-range time is limited to less than 2 days, the following parameters will be given priority in the test schedule:

FC-1 and FC-2 – Relative bearing (full coverage)
– Short range (passive target)

FC-4 and FC-5 – True bearing (full relative bearing coverage)
– Long, medium, and short range (active target)

DATA ACQUISITION

Bearing Data, Automatic Track

Bearing	Sector	Limits
FC-1, -4 and -5	Relative 205° clockwise to 155° relative	Radiate cutout is employed from 155° relative CW to 205° relative (50°) to protect the STIR.
FC-2	Relative 052° clockwise to 310° relative	Radiate cutout is employed from 310° relative CW to 052° relative (102°) to protect the CAS and bridge area.

Range Data, Automatic Track

FC	Range, yards	Sector Size, yards	Limits, yards
FC-1, -4, and -5	*0–50k yards	1k	50k
FC-2	*0–100k yards	1k	100k

*Represents acquisition limits, not required data limits. It is neither expected nor required that all sectors be filled. Priority shall be given to acquiring continuous data (passive target or no-delay changes on active target) for several sectors, then to extended ranges in the upper 50% of the range window, ie 50k yards and under for the CAS (FC-1, -4, and -5) and 100k yards and under for the STIR (FC-2). Recommend 40k-yard and 80k-yard upper limits respectively, to allow 8-inch plot formatting.

Note: Range index values used for FC-1 and -2 shall be recorded for later inclusion in the report.

DATA PROCESSING AND REPORTING

Data are automatically recorded on a 7-track reel-to-reel magnetic tape. Each FORACS range is responsible for writing its own data conversion software as delineated in NOSC specification 55910-0105751, MK 92 Data Collection Software Specification.

DATA ANALYSIS

Bearing Data

Bearing		Limits
Minimum:	4 valid points per 10° sector	None. (Structural interference may limit valid data sector.)
Desired:	7 valid points per 10° sector	

Range Data

Minimum: 4 valid points per 1000-yard sector (any mode) to 50k yards (CAS) and 100k yards (STIR).

Desired: 7 valid points per 1000-yard sector.

DATA REPORT

Text

Benchmark data/lost motion for STIR.

Train alignment for STIR, gun, and launcher compared to deck theodolite.

Plots

Relative bearing error vs actual relative bearing for FC-1 centered at 000° relative.

Relative bearing error vs actual relative bearing for FC-2 centered at 180° relative.

Normalized true bearing error vs actual relative bearing for FC-4 and FC-5 centered at 000° relative. (Normalize with respect to the MK 92 gyrocompass data.)

Range error vs actual range and vs time of day for FC-1, -2, -4, and -5.

MK 92 gyrocompass heading error vs time of day for both dockside and on-range data.

APPENDIX A. MANUAL DATA ACQUISITION PROCEDURE

It may be desirable to acquire data manually when, for example, verification of the automated acquisition mode is required or the ship's magnetic tape system is inoperable. Equipment settings and tracking locations will remain unchanged. Targets will be tracked at the TOTE displays. Data, time, and mark numbers will be hand recorded. The following data will be acquired:

FC-1 – True bearing (Bya) to 0.01° and range (Ra), yards

FC-2 – True bearing (Bya) to 0.01° and range (Ra), yards

FC-4 – True bearing (Bya) to 0.01° and range (Ra), yards

FC-5 – True bearing (Bya) to 0.01° and range (Ra), yards

Signal data converter (SDC) – Own-ship heading to 0.01°*

*MK 92 gyrocompass data will be read at the signal data converter in the equipment room.

All data analysis, text, and plots except the FC-1 and FC-2 bearing plots will comply with the On-Range Procedures and the Data Processing and Reporting sections of this instruction. The FC-1 and FC-2 bearing plots in the manual acquisition mode will show normalized true bearing error vs actual relative bearing (normalized with respect to the MK 92 gyrocompass).

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